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NASA TECH BRIEF

PERT "C"

The problem:

To develop a technique for planning, evaluating and graphically portraying in an orderly related sequence, the activities necessary to achieve a stated objective.

The solution:

A computer program, PERT (Program Evaluation and Review Technique), which provides a method for accomplishing the goals listed above.

How it's done:

An increment of work, such as a major developmental project, or a part of one, may be broken down to any desired degree of detail into meaningful subincrements or tasks so that every task conforms to this statement: A particular task cannot begin until certain other tasks are complete. This relationship between tasks is known as a constraint. It can be diagrammed by representing the tasks as lines terminating at points of constraint.

Tasks which are defined by points of constraint are known as activities, and points of constraint are known as events. An activity is named by the events it connects, known as predecessor event and successor event. A representation of activities according to their constraint relationships is known as a PERT network.

An event is an instantaneous occurrence whose accomplishment must be known at an unambiguous point in time. In this program an event is more narrowly defined as a point in the work progress at which the last of a set of one or more activities, each directly constraining another set of one or more activities, is completed. An activity is the time-consuming effort or work necessary to proceed from one event to another.

If the constraint relationships as shown on a network, the date of each initial event, and the elapsed time required for each activity are known, the completion date of every activity and event in the network can be calculated. The completion date of an event must be calculated before the expected completion date of any activity succeeding this event can be calculated. The expected completion date of an event must be remembered until after the last expected completion date of activities directly succeeding this event is calculated. To satisfy these two requirements, an activity record must be encountered before the record of any of its direct or indirect successor activities is encountered. To simplify the processing problem, the activity records must be encountered in predecessor-event groups. In other words, the activities must be encountered in order according to their position in the network, that is, in topological order. This PERT program handles networks in which the event numbering system is assumed to be random with respect to topology, and the raw data are introduced into the computer in event-number sequence. The activities are rearranged in topological order by the computer.

Given externally imposed scheduled completion dates for terminal activities, the latest allowable completion data for each activity can be calculated. The latest allowable completion date of an activity is the latest date on which the activity can be completed with the expectation of completing each and every terminal activity on or before its scheduled completion date. The latest allowable completion date for preceding activities is also the latest allowable starting date for the most critical succeeding activity. Latest allowable completion dates are computed conversely to expected completion dates. Activity elapsed times are cumulatively subtracted from a scheduled date along the various paths

(continued overleaf)

between a given event and the objective event. The latest allowable completion date is selected as the smallest of the possible values thus obtained.

The procedure for making the necessary calculations for a PERT network has been programmed as 14 different programs, called passes. In order for the computer to proceed from program to program for a network and from network to network without operator intervention, the 14 programs are stacked on a system tape as 14 single self-loading records. The first program is loaded into core by a load tape sequence. Incorporated into the system is the ability to recover semiautomatically from a bad data tape; that is, the operator is instructed, through on-line print, to change the appropriate tape and press the START key. The computer then "backs up" through as many programs as necessary and resumes processing.

A single computer operation can produce up to 28 output runs. Run 1 will provide output information on all activities in the network except those deleted through special options. Runs 2 through 28 will provide up to 27 single terminal event runs; that is, information on only those activities on a path of the network which leads to a specified event (usually a terminal event). Within each run the calculated results can be listed (1) by successor event number and predecessor event number, (2) by paths of criticality (by slack and expected date), (3) by expected date and successor event number, (4) by scheduled or latest allowable date and successor event number, (5) by department, expected date, and successor event number, or (6) by master schedule code, expected date, and successor event number.

For each activity and for all sorts, except the master sort, the program records the predecessor event number, the successor event number, the activity description, the individual activity time (weeks), the expected date (month, day, year), the allowable date (month, day, year), the scheduled date or actual date, if it is a completed activity, (month, day, year), the slack time (weeks), the input resources, the time remaining from the date of the report to the expected completion date of the activity, and the organization associated with the activity.

For the master schedule sort, the program records the successor event number, the activity description, the expected date, the allowable date, the scheduled date or actual date if it is a completed activity, and the slack time.

Notes:

1. This program is written in COBOL for use on the UNIVAC 1108 computer.
2. Inquiries concerning this program should be directed to:

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